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CHAPTER 3
AFFECTED ENVIRONMENT

INTRODUCTION

The Affected Environment for the proposed Blue Sky Project (Project) discusses environmental, social, and economic factors currently existing within the Blue Sky Project Area (Project Area). The material presented here has been guided by management issues identified by the RFO, public scoping, and by interdisciplinary field analysis of the area.

The critical elements, as listed in BLM's NEPA Handbook H-1790-1 (BLM 1988b), and other resource elements of the human environment have been considered. The elements of the human environment, including critical elements, their status in the Project Area, and their potential to be affected by the proposed Project are listed in **Table 3-1**. Those items listed as 'none present' would not be affected or impacted by the Project or the No Action Alternative and are not addressed further in this document.

Table 3-1
Elements of the Human Environment, Blue Sky Project
Atlantic Rim Interim Drilling Program Carbon County, Wyoming - 2001

Element	Project Area Status	Addressed in Text
Geology/Minerals/Paleontology	Potentially affected	Yes
Climate and Air Quality	Potentially affected	Yes
Soils	Potentially affected	Yes
Water Resources (including surface and groundwater quality)	Potentially affected	Yes
Vegetation/Wetlands/Noxious Weeds (including riparian zones, invasive species, threatened and endangered species, and special status species)	Potentially affected	Yes
Range Resources and Other Land Uses	Potentially affected	Yes
Wildlife/Fisheries (including threatened and endangered species, and other special status species)	Potentially affected	Yes
Recreation	Potentially affected	Yes
Visual Resources	Potentially affected	Yes
Cultural Resources	Potentially affected	Yes
Socioeconomics	Potentially affected	Yes
Environmental Justice	Potentially affected	Yes
Transportation	Potentially affected	Yes
Health and Safety	Potentially affected	Yes
Noise	Potentially affected	Yes
Areas of Critical Environmental Concern	None present	No

Table 3-1
Elements of the Human Environment, Blue Sky Project
Atlantic Rim Interim Drilling Program Carbon County, Wyoming - 2001

Element	Project Area Status	Addressed in Text
Prime or Unique Farmlands	None present	No
Floodplains	None present	No
Native American Religious Concerns	Potentially affected	Yes
Hazardous or Solid Wastes	Potentially affected	Yes
Wild and Scenic Rivers	None present	No
Wilderness	None present	No

GEOLOGY/MINERALS/PALEONTOLOGY

Physiography, Topography, and Landforms

The Project Area occupies the southeastern portion of the Greater Green River Basin, a large intermontane structural and topographic basin that is part of the Wyoming Basin Physiographic Province. The Project Area is located in an area of northwest/southeast trending ridges that have been greatly dissected by the numerous drainages of Muddy Creek, Cow Creek, Wild Cow Creek, and Dry Cow Creek. Landforms consist of ridges, finger ridges, knolls, hills, and gentle to moderate slopes. Elevations range from 6,200 feet to 7,630 feet (Hatcher and Davis 2001). State Highway 789, upgraded BLM roads, and two-track trails provide access to the Project Area.

Geology

The Greater Green River Basin began developing about 70 million years ago and filled with sediments eroded from surrounding highlands and mountains during the late Cretaceous and early Tertiary Periods. The Project Area lies within the northern part of the smaller Washakie Basin.

The Lewis Shale of Late Cretaceous age is exposed at the surface within the Project Area. This formation consists of a thick sequence of shale, siltstone and sandstone that accumulated in deltaic, interdeltaic, and marginal marine environments within a shallow epicontinental sea that extended northward from the Gulf of Mexico to the Arctic Ocean in the Maestrichthian (Winn et al. 1985a, 1985b, 1985c). These sediments were derived from the eroded Wind River Range to the north. The Lewis Shale is underlain by approximately 12,000 feet of sedimentary rock, which in turn lies on a basement complex of Cambrian and Precambrian metamorphics and intrusives. The configuration of the basement rock forms the Washakie Basin at depth. At the surface, structural features define the basin margins. These structural features include the Great Divide Basin to the north, the Rock Springs Uplift to the west, the Danforth Hills to the south, and the Sierra Madre Mountains to the east.

By Late Cretaceous time this seaway had retreated eastward and the marine deposits of the Lewis Shale were replaced progressively upward by beach, estuarine, and continental deposits of the Fox Hills Sandstone and Lance Formation, respectively, that spread westward in response to the Sevier and Laramide orogenies. The Laramide orogeny, resulted locally in the uplift of the Sierra Madre Mountains and the subsidence of the Washakie Basin. The latter was filled with Tertiary deposits of the Fort Union and Wasatch Formations during Paleocene and Eocene time, respectively.

In places along the modern Muddy Creek and Cow Creek and atop modern terraces and buttes, the Lewis Shale is overlain by a thin veneer of much younger, unconsolidated sediments of Quaternary age. These sediments include alluvium, colluvium, stream terrace gravels, and wind-blown sands that are Late Pleistocene to Holocene in age.

Late Cretaceous rocks exposed at the surface and underlying the Project Area consist of a complex sequence of sedimentary units, including sandstone, shale, coal, and carbonaceous shale. These sediments were predominantly shed from the Sevier orogenic belt to the west and deposited along the western edge of the interior Cretaceous sea (Roehler 1990). Deposition occurred predominantly during two major transgression-regression periods of the sea.

Underlying the Lewis Shale in the Project Area is the Mesaverde Group, which contains abundant carbonaceous shale and coal. The Mesaverde Group, which outcrops along the western slope of the Sierra Madre Uplift, is more than 2,500 feet thick. Resistant sandstone beds of the Mesaverde Group form the Atlantic Rim escarpment located immediately north of the Project Area. The Mesaverde Group is overlain by the Lewis Shale and the Lance Formation in the western portion of the Project Area.

Numerous thin coal seams are present in the Allen Ridge and upper Almond Formations, members of the Mesaverde Group. These coal beds are targeted as having the greatest potential for CBM production. The lateral continuity of the coal seams is variable (Hamilton 1993). Geophysical logs from CBM test wells within the Project Area indicate that the coal beds are somewhat discontinuous laterally, however, data for coal seam correlation is limited.

Late Cretaceous and younger surface rocks are underlain by Phanerozoic sedimentary rocks that range from Cretaceous to Cambrian in age. The Phanerozoic sediments are underlain by Precambrian metamorphic bedrock that comprises part of the ancient North American shield.

Mineral and Energy Resources

The three primary mineral commodities occurring in Carbon County are coal, natural gas, and oil (Hoffman and Nunley 2000). All three occur in the Project Area, although coal mining has been of least significance to date. Additional mineral resources occurring within the Project Area include uranium, construction aggregate, and geothermal resources.

Coal reserves in the Greater Green River Basin have been estimated at nearly 1,300 trillion tons (Scott et al. 1995). In the Washakie Basin, coal occurs in the Mesaverde Group and the Fort Union Formation. Within the Project Area, coal primarily occurs in the Allen Ridge and Almond

Formations within the upper part of the Mesaverde Group. The coal is sub-bituminous to high-volatile C bituminous in rank (Tyler et al. 1995). Coincident with the Fort Union and Mesaverde coal seams of the Washakie Basin are significant quantities of CBM. Scott (et al. 1994) estimate total reserves in the Greater Green River Basin at approximately 300 trillion cubic feet. Two CBM fields have been explored for CBM resources in the eastern Washakie Basin: the Dixon Field (T.12N. R.90W.), and the Cow Creek Field (T.16N. R.92W.), both of which target Mesaverde coal seams.

The Washakie Basin has been explored and developed for oil and gas resources for many years. A number of formations have proven production, however Cretaceous-age formations have been the most productive. The coalbeds of the Mesaverde Group, underlying the Lewis Shale, are the formation objective for the proposed CBM exploratory wells. Two abandoned wells, the Unit 34-10 and Federal Cherokee Creek 23-15, are located within the Project Area. These wells are conventional oil wells that were plugged and abandoned in the mid-1960s.

Geologic Hazards

Potential geologic hazards include landslides, subsidence, and known or suspected active faults. Landslide potential is greatest in areas where steep slopes occur, particularly where the geologic dip of rock formations is steep and parallel to slope, or where erosional undercutting may occur. Landslides occur east of the Project Area in steeper regions of the Sierra Madre Mountains, but none have been mapped in the Project Area (Case et al. 1991). Slope gradients are mild to steep in the Project Area. Although not specifically mapped, unstable soils in steep areas may be susceptible to slumping, sliding, and soil creep. Generally, slope gradients within the Project Area are best described as mild.

Paleontology

Paleontologic resources include the remains or traces of any prehistoric organism which have been preserved by natural processes in the earth's crust (BLM Information Bulletin WY-93-371). Energy minerals such as coal, oil shale, lignite, bitumen, asphalt, and tar sands, as well as some industrial minerals such as phosphate, limestone, diatomaceous earth, and coquina, while of biologic origin are not considered fossils in themselves. However, fossils of scientific interest may occur within or in association with such materials. Fossils of scientific interest include those of particular interest to professional paleontologists and educators. Vertebrate fossils are always considered to be of scientific interest. Other kinds of fossils may be placed in this category by the State Director and field managers, in consultation with BLM staff paleontologists or other expertise.

Paleontologic resources within sedimentary deposits in the Project Area record the history of animal and plant life in Wyoming during the Late Cretaceous- the time represented by the Lewis Shale. The Lewis Shale is known to yield scientifically significant vertebrate fossils in several areas of Wyoming, but no specific localities have been reported from the Project Area. Fossils known from the Lewis Shale comprise a large and varied marine invertebrate fauna, including many genera of bivalves, baculites, scaphites, and ammonites (Gill et al. 1970) and isurid shark teeth (Breithaupt

1985). Although significant fossils are known from the Lewis Shale from some areas of Wyoming, the potential for discovery of scientifically significant fossils in the Project Area is considered to be moderate to low, when compared with other Late Cretaceous age formations in Wyoming.

CLIMATE AND AIR QUALITY

Climate

The Project Area is located in a semiarid, mid-continental,(dry and cold) climate regime. The area is typified by dry, windy conditions, limited rainfall and long, cold winters. The nearest meteorological measurements were collected at Baggs, Wyoming (1979 to present), approximately 18 miles southwest of the Project Area, at an elevation of 6,240 feet (WRCC 2001).

The average annual precipitation at Baggs is 11.20 inches, ranging from 18.5 inches (1983) to 4.63 inches (1989). Precipitation is evenly distributed throughout the year, with minor peaks occurring in May, July, and October. An average of 41.3 inches of snow falls during the year (annual high 104.0 inches in 1983), with December and January being the snowiest months. In the Project Area, annual average precipitation is estimated to be about 8 to 9 inches, based on local BLM precipitation information and Natural Resource Conservation Service (NCRS) range site descriptions.

Temperatures are generally cooler, frost-free periods shorter, and both precipitation and snowfall greater at higher elevations. The region is typically cool, with average daily temperatures ranging between 5°F (low) and 33°F (high) in mid-winter and between 48°F (low) and 86°F (high) in mid-summer. Extreme temperatures have ranged from -50°F to 100°F (both occurring in 1984). The frost-free period (at 32°F) generally occurs from mid-May to mid-September.

The Project Area is subject to strong and gusty winds, reflecting channeling and mountain valley flows due to complex terrain. During the winter months strong winds are often accompanied by snow, producing blizzard conditions and drifting snow. The closest comprehensive wind measurements are collected at the Rawlins, Wyoming, airport nearly 60 miles north-northeast of the Project Area. However, hourly wind data measurements for December 1994 through November 1995 were collected near Baggs, Wyoming, during the Mount Zirkel Wilderness Area Visibility Study. Winds originate from the south to southwest nearly 37 percent of the time. The annual mean wind speed is nearly 10 mph.

The frequency and strength of the winds greatly affect the dispersion and transport of air pollutants. Because of the strong winds in the Project Area, the potential for atmospheric dispersion is relatively high (although nighttime cooling will enhance stable air, inhibiting air pollutant mixing and transport). Dispersion conditions will be the greatest to the north and along the ridge and mountain tops.

Mean annual evaporation ranges from 38 inches (lake) to 55 inches (pan) and potential annual evapotranspiration is 18 inches (U.S. Department of Commerce 1979). Compared to the average annual precipitation of 11 inches, this gives an average annual deficit of approximately 9 inches.

These meteorological and climatological characteristics of the Project Area combine to produce a predominantly dry climate where evaporation exceeds precipitation.

Air Quality

Although specific air quality monitoring is not conducted throughout Project Area, air quality conditions are likely to be very good, as characterized by limited air pollution emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated ranches) and good atmospheric dispersion conditions, resulting in relatively low air pollutant concentrations.

The Wyoming and National Ambient Air Quality Standards set absolute upper limits for specific air pollutant concentrations at all locations where the public has access. The New Source Review-Prevention of Significant Deterioration Program is designed to limit the incremental increase of specific air pollutant concentrations above a legally defined "baseline" level (depending on the location's classification). Incremental increases in Class I areas are strictly limited, while increases allowed in Class II areas are less strict. The Project Area and the surrounding areas are classified as Class II.

While no criteria air pollutant concentration monitoring has occurred in the Project Area, background values measured in the region are well below established standards. Measured air pollutants include: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone, particulate matter less than ten microns in effective diameter (PM_{10}), and sulfur dioxide (SO_2). Assumed background air pollutant concentrations, applicable Wyoming and National Ambient Air Quality Standards, and Class I and II increments (measured in micrograms per cubic meter, or $\mu g/m^3$) are provided in **Table 3-2**.

The background concentration data were provided by the Wyoming Department of Environmental Quality, Air Quality Division (WDEQ AQD 1997) and Colorado Department of Public Health and Environment, Air Pollutant Control Division (CDPHE APCD 1996). These values reflect the most recently available air quality monitoring data collected in the vicinity of the Project Area. An estimate of background air quality concentrations is needed to combine with modeled Project-related air quality impacts and to compare the total predicted impacts with applicable air quality standards. It is important that each pollutant's background concentration, model predictions, and air quality standards are all based on the same averaging times.

Table 3-2
Air Pollutant Background Concentrations, State and Federal Ambient Air Quality Standards, and PSD Increments (μg/m³)

Pollutant/Averaging Time	Measured Background Concentration	State and National Ambient Air Quality Standards	Incremental Increase Above Legal Baseline PSD Class I	Incremental Increase Above Legal Baseline PSD Class II
Carbon Monoxide (CO)				
1-hour	2,299 a	40,000	n/a	n/a
8-hour	1,148 a	10,000	n/a	n/a
Nitrogen Dioxide (NO_2)				
Annual	10 b	100	2.5	25
Ozone				
1-hour	117 c	235	n/a	n/a
Particulate Matter (PM_{10})				
24-hour	20 c	150	8	30
Annual	12 c	50	4	17
Sulfur Dioxide (SO_2)				
3-hour (National)	29 e	1,300	25	512
24-hour (National)	18 e	365	5	91
24-hour (Wyoming)	18 e	260	n/a	n/a
Annual (National)	5 e	80	2	20
Annual (Wyoming)	5 e	60	n/a	n/a

Note:
Measured background ozone concentration data is top tenth percentile maximum 1-hour value; other short-term background concentrations are second-maximum measured values.
n/a = not applicable
Wyoming Ambient Standards from *Wyoming Air Quality Standards and Regulations, Chapter 2– Ambient Standards.*
National Ambient Standards from 40 CFR Part 50.
PSD Increments from *40 CFR Parts 51 and 52 Prevention of Significant Deterioration for Particulate Matter, EPA Final Rule.* Federal Register Vol. 58, No. 105, Thursday, June 3, 1993.

In recent years there has been concern regarding the potential impacts of oil, gas, and other activities to air quality and air quality related values (acid deposition) in distant Class I and sensitive Class II airsheds. The closest federally-mandated Class I areas located potentially downwind (northeast or southeast) of the Project Area are the Mount Zirkel Wilderness and the Rawah Wilderness located an estimated 46 and 82 miles southeast of the Project Area, respectively, in northern Colorado. The U.S. Forest Service manages both of these areas. **Table 3-3** shows Distant Class I and Class II wilderness areas or monuments located within 100 miles of the Project Area.

Table 3-3
Class I and II Wilderness Areas and National Monument
Within 100 Miles of the Project Area

Area	State	Federal Classification	Distance[1] (miles)	Managed By
Huston Park	Wyoming	II	29	USFS
Encampment River	Wyoming	II	43	USFS
Mount Zirkel	Colorado	I	46	USFS
Savage Run	Wyoming	II[2]	62	USFS
Platte River	Wyoming and Colorado	II	64	USFS
Dinosaur National Monument	Colorado and Utah	II[3]	72	NPS
Rawah	Colorado	I	82	USFS

Notes:
1 Distances are south and east of the Project Area, except for Dinosaur National Monument, which is southwest of the Project Area.
2 The State of Wyoming manages the Savage Run Wilderness as a Class I air quality area.
3 The State of Colorado manages this Monument as a Class I air quality area.

Continuous visibility-related optical background data were collected at the Class I Bridger Wilderness Area in Wyoming and the Class I Rocky Mountain National Park (just south of the Class I Rawah Wilderness Area) in Colorado, as part of the Interagency Monitoring of Protected Visual Environments program. Visibility in the Central Rocky Mountains is very good (averaging over 70 miles Standard Visual Range), with fine particle impacts accounting for nearly half of the average degradation (Sisler 1996). In addition, background atmospheric deposition (acid rain) impacts were monitored at the National Acid Deposition Program/National Trends Network sampling station near Pinedale, Wyoming, and site-specific lake chemistry (pH, acid neutralizing capacity, elemental concentrations, etc.) background data have been collected by the U.S. Geological Survey (Water Quality Division) in several high mountain lakes in the nearby wilderness area.

The WDEQ AQD is the primary air quality regulatory agency responsible (under their EPA approved State Implementation Plan) for determining potential impacts once detailed development plans have been made, subject to applicable air quality laws, regulations, standards, control measures and management practices. Therefore, the State of Wyoming has the ultimate responsibility for reviewing and permitting Project Area air pollutant emission sources before they become operational. Unlike the conceptual "reasonable, but conservative" engineering designs used in this EA, the WDEQ AQD air quality preconstruction permitting would be based on very site-specific, detailed engineering values, available as part of the permit application.

SOILS

Soils in the Project Area are deep and well drained and formed in alluvium and colluvium derived predominantly from sandstone with some influence from shales. Many of these soils have a sandy loam surface overlying sandy clay loam and sand. Depth to bedrock is generally greater than 20 inches, with depth generally increasing with distance from ridges and outcrops.

Generally, soils in the Project Area are of moderate strength, permeability, and productivity. Productivity can be affected by changes in precipitation, vegetative cover, and compaction. Removing vegetation will increase the potential for wind and water erosion, depending on clay content and grain size. Soils with more clay could be strengthened through compaction, but the reduction in pore spaces would reduce productivity. Clay in lower strata of the soil retards permeability and may cause salt to build up in the soil, reducing productivity.

The soils in this portion of Carbon County were studied and mapped to an Order 3 scale by the BLM in 1979 and 1980. This survey covers the Project Area. Mapping by the NRCS is available in this portion of Carbon County on a contracted basis of agricultural lands. No lands within the proposed Project Area were generally part of any NRCS mapping. Only BLM information was utilized. Soil series within the survey area were verified according to previously established information, i.e., previously established soil series or mapping units, wherever possible.

The predominant map units in the Project Area were Absher-Forelle complex and Rallod-Abston-Pinelli complex. The Absher-Forelle complex occurs on nearly level and gently sloping footslopes and alluvial fans. Slopes are smooth. The Rallod-Abston-Pinelli complex occurs on underlying to hilly residual uplands on shale bedrock. Slopes are predominantly convex with concave slopes along drainageways. Most have aridic moisture regimes and frigid temperature regimes. Climates are usually dry and cold. According to established range site descriptions for the associated soil series descriptions, 10-14 inches of rainfall occur during the year, with an average air temperature of 35-40°F.

Plant growth begins about April 15 and continues up to July 15, approximately. Fall growth will usually occur if moisture is available. Because of the high, dry air, nighttime radiation cooling can produce freezing temperatures any month of the year. The climax plant community is characterized by species having high tolerance to salt and capable of withstanding drought conditions. The potential plant communities on the Absher and Rallod soils are mainly western wheatgrass, bottlebrush squirreltail, Indian ricegrass, and Gardner saltbrush. The vegetation of this area is a mixture of 55 percent grasses and grass-like plants, 5 percent forbs, and 40 percent woody plants.

The Absher-Forelle complex map unit is 50 percent Absher silty clay and 30 percent Forelle loam. The Rallod-Abston-Pinelli complex map unit is 40 percent Rallod clay, 25 percent Abston clay and 20 percent Pinelli loam. In general, the soils in this area may be light or dark-colored and usually exceed 20 inches in depth. The topsoil is high in exchangeable salt and/or sodium. Internal water movement and permeability is slow to moderate. Soil genesis classification of the majority of soils within this area are haplargids, torriorthents, camborthids, natrargids, and torrifluvents.

Runoff is medium to rapid and the hazard of water erosion is moderate to severe. The hazard of soil blowing is moderate. In addition to these physical limitations of the soils in many areas, chemical limitations exist primarily in terms of salinity or sodium-affected soils. A list of the BLM map units found in and adjacent to the Project Area is presented in **Table 3-4**.

Table 3-4 BLM Map Units Found in and Adjacent to the Project Area	
Mapping Unit Number	**Mapping Unit Description**
225	Cushool-Rock River sandy loams, 3-10%
232	Blazon-Delphill-Diamondville complex, 6-30%
234	Rock River-Ryark-Cushool complex, 3-15%
237	Seaverson-Blazon complex, 3-15%
247	Cushool-Diamondville-Worfman complex, 3-15%
273	Elk Mountain-Yamac Variant sandy loams, 0-15%
289	Absher-Forelle complex, 1-6%
295	Rallod-Abston-Pinelli complex, 2-25%
333S	Laclede alkali-Laclede complex, 0-3%
449	Dines-Dines overflow complex, 0-2%

WATER RESOURCES

The Project Area is located in the Muddy Creek watershed of the Little Snake River drainage, which is a part of the Colorado River Basin. Surface waters include the perennial Little Snake River, the intermittent to perennial Muddy Creek, ephemeral Dry Cow Creek and Wild Cow Creek and several unnamed ephemeral channels and manmade ponds. A public water reserve is located upstream from the Project Area. Groundwater resources include free water contained within relatively shallow aquifers that are used or could be utilized for culinary, agricultural, and/or industrial purposes. Overall, 0.09 Mgal/d (million gallons per day) of groundwater are used, divided equally among domestic, livestock, and irrigation uses. A total of 5.97 Mgal/d of surface water is used, with 0.11 Mgal/d used for livestock and the rest used for irrigation within the watershed.

Surface Water

Quantity

The Project Area is located within the Little Snake River drainage basin. Dry Cow Creek and Wild Cow Creek ephemeral tributaries to Muddy Creek, are found within the Project Area. Muddy Creek is an intermittent to ephemeral stream that carries water most of the year to its confluence with the Little Snake River near Baggs.

Annual peak flows for all streams within the Project Area generally occur in late May through early June in response to snowmelt. Baseflows are reached in the fall and continue through March until low elevation snowmelt initiates the rising limb of the hydrograph. A United States Geological Survey (USGS) continuous gaging station on the Little Snake River near Dixon recorded a maximum peak discharge of approximately 13,000 cfs on May 16, 1984, while minimum flows of near 0 cfs occur in late summer and early fall at the end of the irrigation season (Druse et al. 1994).

Quality

There are seven USGS surface water quality stations in and around the Project Area, including two on the Little Snake River, two on Muddy Creek, and one each on Cow Creek, Dry Cow Creek, and Wild Cow Creek. Average sample data from each of the stations are shown in **Table 3-5**. The data suggest that surface waters in the Project Area are of moderately high pH (8.1 to 9.2) and contain moderate quantities of dissolved oxygen (9 to 11 mg/l).

Table 3-5
Surface Water Quality in the Project Area

	USGS Surface Water Quality Station[1]						
	Cow Creek	Dry Cow Creek	Wild Cow Creek	Muddy Creek	Muddy Creek	Little Snake River	Little Snake River
Station Number	09115080	09258200	WLDCWCK:0	09258900	09259000	09257000	09259050
Sample Period	1978-1979	1975-1980	1986-1993	1976-1978	1957-1991	1957-1988	1980-1997
Number of Samples[2]	20	9	42	3	41	107	100
pH, standard units	9.2	8.6	9.0	8.6	8.2	8.1	8.1
Conductance, mmhos/cm	2925	2162	2663	1350	966	259	366
Total Dissolved Solids[3]	1801	1438[4]	1955	913	630[4]	158	243
Suspended Solids	133	1111	NM[5]	6198	3191	154	228
Turbidity	284 NTU	1013 JTU	NM	1260 NTU	NM	13 JTU	167 NTU
Hardness as $CaCO_3$	174	37	334	315	270	111	151
Oxygen	9	11	NM	11	10	9	10
Sodium	560	98	550	200	286	11	26
Calcium	19	9	20	54	42	30	34
Magnesium	31	4	68	44	40	8	12
Potassium	11	4	7	7	9	2	2
Bicarbonate	870	170	1000	373	308	159	190
Carbonate	186	4	91	0.5	NM	0	1
Sulfate	181	65	438	380	320	25	54
Chloride	132	21	60	65	32	3	2
Fecal coliform, #/100 ml	535	NM	NM	NM	8	NM	351

1 Data available on the Internet at http://www.wrds.uwyo.edu
2 Total number of grab samples analyzed; not every parameter was analyzed in every sample
3 All units are mg/l except as noted
4 TDS calculated from specific conductance due to lack of sample data
5 NM = not measured

Generalizations among other sample parameters are made difficult by high variability between stations. Trends become apparent, however, when the stations are divided according to the surface water designation. **Table 3-6** averages select parameters from **Table 3-5** into ephemeral, intermittent, and perennial classes.

Table 3-6
Surface Water Quality Comparison

Representative Surface Waters	Stream Class		
	Ephemeral	Intermittent	Perennial
	Cow Creek, Dry Cow, and Wild Cow Creek	Muddy Creek	Little Snake River
Total Dissolved Solids[1]	1,731	772	201
Sodium	403	243	19
Calcium	16	42	10
Magnesium	34	48	32
Potassium	7	8	2
Bicarbonate	680	341	175
Carbonate	93	0.5	0.5
Sulfate	228	350	40
Chloride	71	49	3
SAR	14.1	6.1	0.7

[1] All units are mg/l except SAR, which is unitless

Water quality in ephemeral streams is represented by the Cow Creek, Dry Cow Creek, and Wild Cow Creek monitoring stations. The ephemeral quality is characterized by high TDS (1,731 mg/l) and sodium and bicarbonate dominance as the major dissolved ions. Sodium dominance is reflected in the relatively high sodium adsorption ratio (SAR) of 14.1.

The two Muddy Creek monitoring stations represent intermittent surface water quality. Muddy Creek has actually been classified as an intermittent to perennial stream (Higley 1996), but its classification has been simplified for **Table 3-6**. Intermittent streams in the Project Area are characterized by moderate TDS (772 mg/l) and the replacement of bicarbonate by sulfate as the major anionic species. Sodium dominance is reflected in the SAR of 6.1, but is less marked than in ephemeral flows.

Two Little Snake River stations monitor perennial water quality in the Project Area. Perennial quality is characterized by a significantly reduced TDS (201 mg/l) from intermittent and ephemeral streams. Sodium is also displaced by calcium as the major cationic species. This is reflected in the low SAR (0.7 mg/l).

The WDEQ classifies Wyoming streams according to quality and degree of protection. Four classes have been identified as follows (WDEQ 2000).

Class 1: Those surface waters in which no further water quality degradation by point source discharges other than from dams will be allowed. Nonpoint sources of pollution shall be controlled through implementation of appropriate best management practices. Considerations employed during the designation of these waters include water quality, aesthetic, scenic, recreational, ecological, agricultural, botanical, zoological, municipal, industrial, historical, geological, cultural, archaeological, fish and wildlife, the presence of significant quantities of developable water and other values of present and future benefit to the people.

Class 2: Surface water other than Class 1 determined to be presently supporting game fish, have the hydrologic and natural water quality potential to support game fish, or include nursery areas or food sources for game fish.

Class 3: Those surface waters, other than those classified as Class 1, which are determined to be presently supporting nongame fish only, have the hydrologic and natural water quality potential to support nongame fish only, or include nursery areas or food sources for nongame fish only.

Class 4: Those surface waters, other than those classified as Class 1, which are determined to not have the hydrologic or natural water quality potential to support fish and include all intermittent and ephemeral streams.

Cow Creek and Muddy Creek are identified by the WDEQ as Class 3 waters, as noted in the RMP. Dry Cow Creek and Wild Cow Creek are intermittent streams that are not able to support fish and are classified as Class 4 streams. WDEQ Rules and Regulations state that no pollutant shall be permitted if it adversely affects surface water. Mesaverde aquifer water exceeds SAR, specific conductance, pH, dissolved chloride and dissolved sulfate levels occurring in surface waters of Muddy Creek.

The RFO has identified the Muddy Creek drainage as requiring special management due to unacceptable existing levels of salt and sediment. Causes of this are mainly natural, but have been increased by human activity. Without using BMPs, surface disturbance would increase erosion, adding sediment and salt to the drainage.

Waters of the U.S.

Most of the surface water features in the Project Area qualify as waters of the United States. Waters of the U.S. include territorial seas; interstate waters; navigable waterways (such as lakes, rivers, and streams); special aquatic sites and wetlands that are, have been, or could be used for travel, commerce, or industrial purposes; tributaries; and impoundments of such waters. All channels that carry surface flows and that show signs of active water movement are waters of the U.S. Similarly, all open bodies of water (except ponds and lakes created on upland sites and used exclusively for agricultural and industrial activities or aesthetic amenities) are waters of the U.S. (EPA 33 CFR § 328.3(a)). Such areas are regulated by the EPA and COE. Many of the drainage channels identified on the USGS topographic maps are vegetated swales that are not considered to be waters of the U.S. by the COE. Any activity involving excavation or discharge of dredge or fill material in a manner

that affects waters of the U.S. is subject to regulation by the COE pursuant to Section 404 of the CWA. Activities that modify the morphology of stream channels are also subject to regulation by the WSEO. Special aquatic sites and wetlands are discussed in greater detail in the Vegetation Section 3.5.

Groundwater

The Project Area is located in the Colorado Plateau and Wyoming Basin groundwater regions described by Heath (1984); the Upper Colorado River Basin groundwater region described by Freethey (1987); and Washakie Basin described by Collentine et al. (1981) and Welder and McGreevy (1966). Groundwater resources include deep and shallow, confined and unconfined aquifers. Site-specific groundwater data for the Project Area are limited. Existing information comes primarily from WOGCC oil and gas well records, WSEO water-well records, and the USGS (Weigel 1987). Regional aquifer systems pertinent to the Project Area are discussed by Heath (1984), Freethey (1987), and Driver et al. (1984). Basin-wide evaluations of hydrogeology specific to the Project Area have been investigated by Collentine et al. (1981). The most relevant hydrogeologic study specific to the Project Area is by Welder and McGreevy (1966).

Location and Quantity

Groundwater in the Washakie Basin is generally found in artesian aquifers, although it is also present in unconfined alluvial valleys and in isolated, saturated outcrops (Welder and McGreevy, 1966). **Table 3-6** summarizes the water-bearing characteristics of the geologic formations present in the Project vicinity. Of the geologic units listed in the table, Welder and McGreevy (1966) suggest that those capable of producing the greatest quantity of water include the following: Quaternary alluvium; Tertiary deposits in the Browns Park, Wasatch, and Fort Union Formations; Cretaceous formations, including Mesaverde, Frontier, and Cloverly; the Sundance-Nugget Sandstone of the Jurassic Age; and the Tensleep and Madison Formations of the Paleozoic Era. **Table 3-7** contains a brief description of the major aquifers in the Project Area.

Quaternary aquifers in the Washakie Basin are comprised of alluvial deposits along major floodplains and isolated windblown and lake sediments. The major Quaternary aquifers in the vicinity of the Project Area occur in alluvial deposits along the Little Snake River and Muddy Creek and in windblown segments along the Sand Hills. Groundwater flow within the sandy Quaternary aquifers is typically downward toward permeable underlying formations (Collentine et al. 1981).

Table 3-7
Water-Bearing Characteristics of Geologic Formations in the Washakie Basin[1]

Era	Period	Geologic Unit	Thickness	Hydrologic Properties		
				Well Yield (gpm)	Transmissivity (gpd/ft)	Permeability (gpd/ft^2)
Cenzoic	Quaternary		0-70	<30	168-560	21-62
	Tertiary	Browns Park Fm.	0-1,200	3-30	100-10,000	NM
		Wasatch Fm.	0-4,000+	30-50	150-10,000	0.04-18.2
		Fort Union Fm.	0-2,700+	3-300	<2,500	<1
Mesozoic	Upper Cretaceous	Lance Fm.	0-4,500+	<25	<20	0.007-8.2
		Fox Hill Sandstone	0-400	NM	10-20	0.9
		Lewis Shale	0-2,700+	2-25[2]	0.03-50	0.002-0.9
		Almond Fm.[3]	0-600	NM	2,000-8,000	100-800
		Mesaverde Group (incl. Almond Fm.)	300-2,800	<100	<3,000	NM
		Baxter Shale (incl. Steele Shale and Niobrara Fm.)	2,000-5,000+	major regional aquitard between Mesaverde and Frontier aquifers. Hydrologic data unavailable.		
		Frontier Fm.	190-1,900+	1-100+	<100-6,500	NM
	Lower Cretaceous	Mowry Shale	150-525	Regional aquitard. Hydrologic data unavailable.		
		Thermopolis Shale (inclu. Muddy Sandstone)	20-235	Considered a leaking confining unit. Hydrologic data unavailable.		
		Cloverly Fm.	45-240	25-120	340-1,700	1-177
	Upper Jurassic	Morrison Fm.	170-450+	Confininng unit between Cloverly and Sundance-Nugget aquifers. Hydrologic data unavailable.		
		Sundance Fm.	130-450+	27-35	12-3,500	NM
	Lower Jurrasic-Upper Triassic	Nugget Sandstone	0-650+	35-200	<2,166	NM
	Triassic	Chugwater Fm.	900-1,500+	Confinining unit between Sundance-Nugget and Paleozoic aquifers. Hydrologic data unavailable.		
Mesozoic-Paleozoic	Lower Triassic Permian	Phosphoria Fm. (incl. Goose Egg Fm.)	170-460	Probable poor water-bearing capabilities due to low permeability. Hydrologic data unavailable.		
Paleozoic	Permian-Pennsyvanian	Tensleep Fm.	0-840+	24-400	1-374	NM
	Lower and Middle Pennsylvanian	Amsden Fm.	2-260+	Probably poor water-bearing capabilities due to predominance of fine-grained sediments.		
	Mississippian	Madison Limestone	5-325+	<400	Variable	NM
	Cambrian	Indef. Rocks	0-800+	4-250	NM	NM
Precambrian	N/A	Igneous and metamorphic rocks	Unknown	10-20	<1,000	Generally high in upper 200 ft of unit

[1] Adapted from Table V-1 in Collentine et al. (1981). Formations not encountered in Project Area have been omitted.
[2] From well completion records on file with SEO
[3] From Atlantic Rim CBM well test data

Tertiary aquifers in and near the Project Area occur in the Browns Park Formation along the Little

Snake River flood plain and adjacent to the Sierra Madre Uplift, the Fort Union Formation near the Muddy Creek flood plain to the west, and isolated Wasatch Formation outcrops near the center of the Project Area. Groundwater generally flows west-southwest from the higher elevations along the Sierra Madre Uplift toward the low-lying Washakie Basin center and the major streams (Collentine et al. 1981).

Cretaceous aquifers in the Project Area occur in three major geologic formations. From youngest to oldest they are the Almond Formation of the Mesaverde Group, the Frontier Formation, and the Cloverly Formation. The Mesaverde Group is exposed along the eastern slopes of the Project Area, although a mantle of Tertiary deposits unconformably overlies large areas of Late Cretaceous strata. No outcrops of the Frontier or Cloverly Formations are present within the Project Area.

The Cretaceous aquifers are composed of interbedded sandstone, shale, and coal and have demonstrated considerable yields in existing wells (Collentine et al. 1981). Recharge to these water-bearing strata is principally from precipitation infiltration and the movement of groundwater from the overlying Tertiary sediments at their outcrops and subcrops along the elevated eastern margin of the Washakie Basin. Regional groundwater flow direction is toward the west in response to the structural dip and surface topography.

Separated from the Cretaceous aquifers by the impermeable Morrison Formation is the Sundance-Nugget Aquifer of the Jurassic Age. The Sundance-Nugget aquifer is comprised of permeable sandstone with minor quantities of shale, siltstone, and limestone (Collentine et al. 1981). The flow characteristics of the Sundance-Nugget aquifer are not well defined.

The remaining two major aquifers occur in Paleozoic Era rocks. The Tensleep Formation from the Pennsylvania Age consists of fine- to medium-grained sandstone between confining layers of the Chugwater Formation (Triassic) and the Amsden Formation (Pennsylvanian) (Collentine et al. 1981). The Madison aquifer is comprised of limestone and dolomite bordered on the top by the fine-grained Amsden sediments and on the bottom by Cambrian rocks. Wells completed within both of these Paleozoic aquifers have demonstrated yields up to 400 gpm. Groundwater flow is west-southwest in the Project Area.

Driver et al. (1984) suggest that the Browns Park Formation would be the best candidate for large-scale groundwater development. Recharge to the aquifers is generally by precipitation and surface water seepage percolating through permeable overlying materials (Welder and McGreevy 1966).

As shown in **Table 3-8**, one permitted water well exists within one mile of the Project Area. The right to this well is owned by the BLM, however, no Water Well Agreement was required as this well is located outside the one-half mile circle of influence (**Appendix D**).

This well draws water from the Mesaverde aquifer to feed a stock pond. Water quality from this well is indicative of the water that would be produced by Pedco's wells. Water from this well meets standards set by the WDEQ, except Sodium Adsorption Ratio (SAR) and Total Dissolved Solids (TDS). Water from the Mesaverde aquifer exceeds SAR standards for agriculture and TDS

standards for domestic consumption (WRDS 1998).

Table 3-8
Existing Groundwater Wells in Project Vicinity

Formation	Number of Wells	Yield[1] (gpm)
Mesaverde	1	20

[1] WSEO well completion permits

Quality

Groundwater quality is related to the depth of the aquifers, flow between aquifers, and the rock type. Groundwater quality is variable in the Project Area. TDS, an indicator of salinity, is generally less than 2,000 mg/l (slightly saline to saline) in the Project Area, with local concentrations of less than 500 mg/l (considered fresh).

As most existing groundwater wells and the proposed CBM wells of the Project Area occur in Mesaverde aquifers, a detailed Mesaverde groundwater quality analysis has been included. **Table 3-9** lists the major cation and anion composition of Mesaverde groundwater in the Project Area. Sodium and bicarbonate dominate as the major ionic species. Collentine et al. (1981) offer three possible explanations for this dominance: (1) exchange of dissolved calcium for sodium; (2) sulfate reduction resulting in bicarbonate generation; and (3) intermixing of sodium-rich, saline water from low-permeability zones within the Mesaverde or adjacent aquifers.

Table 3-9
Major Ion Composition of Mesaverde Groundwater

Cation	Concentration (mg/l)	Anion	Concentration (mg/l)
Sodium	513	Bicarbonate[2]	1,284
Calcium	7	Carbonate[1]	9
Magnesium	3	Chloride	56
Potassium[1]	5	Sulfate	11

[1] potassium and carbonate concentrations were not measured in CBM samples; values represent composite of USGS data for Mesaverde wells in Project vicinity (USGS 1980)

[2] bicarbonate was not measured; value shown was calculated from ion balance.

Table 3-10 presents a comparison of Mesaverde groundwater with WDEQ suitability standards. The composite results of the three CBM wells analyzed indicate water that is generally suitable for livestock use, but is unsuitable for domestic supply or irrigation without treatment or dilution. Parameters with measured concentrations in excess of Wyoming drinking water standards include iron, manganese, and TDS. Calculated SAR (47.3) and residual sodium carbonate (41 meq/l) exceed the agriculture suitability limits of 8 and 1.25, respectively. Unless the water were mixed with an existing water source of lower sodium and bicarbonate and lower total salinity, irrigation would result in reduction in infiltration in the affected soil.

Table 3-10
Groundwater Quality for Mesaverde Wells in Project Area

Parameter	Concentration[1]	Unit	Groundwater Suitability Standards[2]		
			Domestic	Agriculture	Livestock
Aluminum	0.045	mg/l	---	5	5
Ammonia	0.9	mg/l	0.5	---	---
Arsenic	0.0006	mg/l	0.05	0.1	0.2
Barium	0.36	mg/l	1	---	---
Beryllium	<0.002	mg/l	---	0.1	---
Boron	0.25	mg/l	0.75	0.75	5
Cadmium	<0.0002	mg/l	0.01	0.01	0.05
Chloride	56	mg/l	250	100	2000
Chromium	0.002	mg/l	0.05	0.1	0.05
Cobalt	NM	mg/l	---	0.05	1
Copper	0.03	mg/l	1	0.2	0.5
Cyanide	<5	mg/l	0.2	---	---
Fluoride	1.0	mg/l	1.4 - 2.4	---	---
Hydrogen Sulfide	NM	mg/l	0.05	---	---
Iron	3.06	mg/l	0.3	5	---
Lead	0.004	mg/l	0.05	5	0.1
Lithium	NM	mg/l	---	2.5	---
Manganese	0.102	mg/l	0.05	0.2	---
Mercury	<0.0004	mg/l	0.002	---	0.00005
Nickel	0.041	mg/l	---	0.2	---
Nitrate	<0.03	mg/l	10	---	---
Nitrite	<0.03	mg/l	1	---	10
Oil & Grease[3]	<1	mg/l	Virtually Free	10	10
Phenol	65	mg/l	0.001	---	---
Selenium	<0.005	mg/l	0.01	0.02	0.05
Silver	<0.003	mg/l	0.05	---	---
Sulfate	11	mg/l	250	200	3000
TDS	1,322	mg/l	500	2000	5000
Uranium	NM	mg/l	5	5	5
Vanadium	NM	mg/l	---	0.1	0.1
Zinc	0.3	mg/l	5	2	25
pH	8.2	s.u.	6.5 - 9.0	4.5 - 9.0	6.5 - 8.5
SAR	47.3	<none>	---	8	---
RSC[4]	41	meq/l	---	1.25	---
Radium 226 + Radium 228	0.9	pCi/l	5	5	5
Strontium 90	NM	pCi/l	8	8	8
Gross alpha	NM	pCi/l	15	15	15

[1] boron, ammonia, fluoride, and nitrate/nitrite concentrations from 11 Mesaverde groundwater wells (USGS 1980); remaining concentrations from three Mesaverde CBM wells in Project Area

[2] from WDEQ Water Quality Rules and Regulations, Chapter VIII

[3] reported as total petroleum hydrocarbons

[4] residual sodium carbonate calculated from measured calcium and magnesium concentrations and calculated bicarbonate concentration

The confining beds slow the movement of water, and hence, movement of potential contaminants between aquifers. Although there is some downward movement of the water from the surface units,

most of the groundwater movement, if any, is upward from the deeper aquifers to the shallower aquifers. Concerns have been raised for several gas field projects in southwest Wyoming regarding groundwater quality degradation due to the piercing of confining layers and vertical and horizontal migration and mixing of water of variable qualities. Data suggesting this is a current problem in the Project Area are not available. Improperly completed injection wells could be a potential source of contamination.

VEGETATION/WETLANDS/NOXIOUS WEEDS

Vegetation Cover Types

A biological survey of the Project Area has been conducted (HWA 2001). The Project Area is located in the sagebrush steppe plant community that is typical of the high intermountain desert of south central Wyoming. The primary vegetation cover types, as identified by the Wyoming Gap Analysis Program, are Wyoming big sagebrush (2,240 acres), desert shrub (142 acres), and shrub-dominated riparian (178 acres). The Wyoming big sagebrush cover type typically consists of a mixture of greasewood, Wyoming big sagebrush, rabbitbrush, and saltbush. The desert shrub cover type is often dominated understory grasses and forbs similar to the Wyoming big sagebrush type, with common species including western wheatgrass, little bluegrass, Indian ricegrass, bottlebrush squirreltail, needleandthread, phlox, buckwheat, penstemon, and prickly-pear cactus. Common species in shrub-dominated riparian areas include sagebrush, greasewood, and willow.

The principal riparian habitat within the Project Area consists of a narrow band of vegetation along Cow Creek. Key species in riparian areas include spikesedge, redtop, tufted hairgrass, Kentucky bluegrass, and saltgrass. This cover type typically has very few, if any, trees.

Threatened and Endangered Species

One federally endangered species of plant, blowout penstemon (Penstemon haydenii), has the potential to occur in sandy blowouts in or near the Project Area (HWA 2001). Very small and limited areas of sandy blowouts, the penstemon's prime habitat, may occur in the vicinity of the Project Area. However, no blowout penstemons and no suitable habitat were found in the Project Area during the biological survey.

Species of Concern

Eleven special-concern species of plants may occur within or near the Project Area (HWA 2001). Five of the species (Crandall's rock-cress, little golden-aster, Weber's scarlet-gilia, Rusby's stickleaf, and Rydberg twinpod) are unlikely to occur in or near the Project Area because their preferred habitat types are not present. The remaining six special-concern species (smallflower androstephium, Hayden's milkvetch, Wolf's orache, Payson's tansymustard, Gibben's beardtongue, and many-headed broom groundsel) have low to moderate potential to occur in or near the Project Area. None of these species was found during the biological survey of the Project Area. Appendix

E provides information on the names, sensitivity status, counties in which these species have been documented, notes on their overall range and distribution within Wyoming, probability of occurrence in the Project Area, and descriptions of habitat types in which these special concern plants are found.

Noxious Weeds/Invasive Species

The Project Area is vulnerable to infestations of invasive/noxious weeds such as Canada thistle, musk thistle, black henbane, and halogeton. Infestations of invasive/noxious weeds are relatively minimal within the Project Area at present. However, any newly-disturbed surface would be susceptible to infestations of invasive/noxious weeds. Monitoring for weed infestations and spraying for two consecutive seasons, after emergence but before seeding, has been an effective method of controlling these species.

RANGE RESOURCES AND OTHER LAND USES

Range Resources and Other Land Uses

The Project Area is split between the Doty Mountain Allotment (#00415) in the north and the Cherokee Allotment (#00408) in the south. The Doty Mountain Allotment includes approximately 83,368 acres, 71 percent of which is public land, and supports 6,974 AUMs. The Cherokee Allotment includes approximately 73,966 acres, 89 percent of which is public land, and supports 9,500 AUMs.

About two thirds of the ranges are considered to be in good condition, the remainder are considered to be in excellent, fair, or undetermined condition; less than one percent of the ranges are considered to be in poor condition. The average stocking rate is 12 acres per AUM for the Doty Mountain Allotment and eight acres per AUM for the Cherokee Allotment.

The season of use for both allotments extends from April 1 to December 1. The Project Area lies partially within the winter pasture of the Doty Mountain Allotment where cattle use is rotated within a nine pasture system. The winter pasture is used with a low stocking rate during May, with the principle use period occurring in September through October. No pasture rotation has yet been established for the Cherokee Allotment, but a schedule is expected soon. Spring and fall are currently the principal use periods for both sheep and cattle (BLM 1972, Warren 2000).

The Project Area contains an estimated 1,921 acres of federal surface ownership lands. There are no State of Wyoming or privately-owned lands within the Project Area. The Project is located on federal lands administered by the RFO in accordance with the Great Divide RMP.

Other land uses within and adjacent to the Project Area are agriculture (primarily cattle and sheep grazing), wildlife habitat, oil and natural gas exploration, development, and transmission, and dispersed outdoor recreation (primarily hunting in the fall).

WILDLIFE/FISHERIES

Wildlife

The Project Area includes sagebrush/saltbrush steppe and greasewood wildlife habitats. Many common species of birds, mammals, amphibians, and reptiles may be found within the Project Area. The proposed development is not expected to significantly impact the common species found in the Project Area, therefore, they are not considered in this analysis. Those species being considered for threatened or endangered status, big game species, raptors, and greater sage grouse are considered in this analysis. The area of analysis for wildlife concerns consists of the Project Area, plus a two-mile buffer for greater sage grouse leks, and a one-mile buffer for raptor nests. Wildlife surveys discussed and summarized herein were conducted as part of larger-scale surveys being performed in preparation of the Atlantic Rim CBM Project EIS.

Information regarding the occurrence of species being considered for threatened or endangered status, big game species, raptors, and greater sage grouse near the Project Area was obtained from several sources. Sage grouse lek locations, seasonal big game range designations, raptor nest locations, and locations for threatened and endangered species were obtained from the Wyoming Game and Fish Department's (WGFD) Wildlife Observation System. WGFD big game herd unit annual reports were used for herd unit population statistics. Figure 2 provides locations and ranges in relation to the Project. This existing wildlife information for the Project Area was supplemented through survey data collected by Hayden-Wing Associates (HWA) biologists in 2000 and 2001. These data collections consisted of aerial and ground surveys to: (1) determine occurrence of threatened, endangered, proposed, or candidate species for listing; (2) determine the occurrence, location, size, and burrow density of white-tailed prairie dog colonies; (3) determine the location and activity status of raptor nests; (4) search for previously undocumented greater sage grouse leks and determine the activity status of all leks in the area; (5) locate winter greater sage grouse concentration areas; and (6) determine the occurrence, location, and size of mountain plover habitat and conduct a preliminary presence/absence survey for the species.

Big Game

Three big game species, pronghorn antelope (Antilocapra americana), mule deer (Odocoileus hemionus), and elk (Cervus elaphus), occur in the Project Area during all or parts of the year. Winter ranges are used by substantial numbers of animals only during the winter months (December through April). Winter/year-long ranges are occupied throughout the year, but during winter these ranges are used by additional animals that migrate from other seasonal ranges. Crucial big game range (e.g., crucial winter/year-long range) describes any seasonal range or habitat component that has been documented as a determining factor in a population's ability to maintain itself at a specified level over the long-term. Crucial winter ranges are typically used eight out of ten winters.

Pronghorn Antelope

The Project Area is within the 1,394-square-mile Baggs Herd Unit. The Project Area contains pronghorn seasonal ranges designated as winter and crucial winter/year-long. Pronghorn likely migrate across the southern portion of the Project Area onto the crucial winter/year-long range located in the western portion of the Project Area (HWA 2001). During years with higher snowfall across the winter range, pronghorn congregate on the crucial winter range, resulting in heavy browse use here and only light use of the transition area in the fall and spring. In years with low amounts of snow, the pronghorn are not forced to spend as much time on the crucial winter range. Utilization of important shrub species is then more evenly distributed across this transition area with less use on the plants in the crucial winter range. The current population estimate of 7,000 animals is 22 percent below the Wyoming Game and Fish Department's (WGFD) management objective (HWA 2001). The Baggs antelope herd had experienced low fawn production resulting in slow growth, but production has improved during recent years and the population appears to be rebounding (HWA 2001). The Project Area is located within Hunt Area 53, where the hunter success rate in 1999 was 95.4 percent. The 1999 post hunt season population estimate for the Baggs Herd Unit was 7,000 animals, which is 24.6 percent higher than the 1994-1998 estimated population average of 5,620 (WGFD 2000a). The population objective was increased 25 percent in 1994, from 7,200 to 9,000 animals.

Mule Deer

The Project Area is within the Baggs Herd Unit. The Baggs Herd Unit is very large (3,440 square miles) and contains habitats ranging from subalpine and montane coniferous forests to desert scrub. The Project Area is within the portion of the Unit designated as winter/year-long mule deer range. No mule deer migration routes pass through the Project Area. The 1999 post-hunt population estimate for the Baggs Herd Unit was 18,300 animals. This estimate is slightly below the WGFD's management objective of 18,700 animals (HWA 2001). The Project Area is within Hunt Area 82, where the hunter success rate in 1999 was 56 percent.

Elk

The Project Area is located within the Sierra Madre Herd Unit (2,425 square miles). Most elk in the herd unit utilize spring/summer/fall ranges in the Sierra Madre Mountains, although there are groups using habitats on Atlantic Rim and around McCarty Canyon. During winter, the elk migrate to lower elevation winter range habitats on the west side of the Sierra Madre Mountains and into the Atlantic Rim/Sand Hills areas. Some animals may migrate as far west as the Powder Rim (~40 miles west of Baggs; Porter 1999). However, no major elk migration routes pass through the Project Area (WGFD 2000a). The habitat in the Project Area is designated as elk winter range (1,000 acres). The 1999 post hunt season population estimate for the Sierra Madre Herd Unit of 7,300 animals is 73.8 percent above the WGFD management objective of 4,200. The Project Area is located within Hunt Area 21, where the hunter success rate for 1999 was 37.7 percent.

Upland Game Birds

Sage Grouse

The greater sage grouse receives special consideration because populations are declining over much of its range and it is an important upland game bird in the State of Wyoming. Aerial surveys were conducted during March 2001 to delineate greater sage grouse concentration areas during winter. No greater sage grouse winter locations were identified within the Project Area, however, there were two greater sage grouse winter locations within 0.5 miles of the western boundary of the Project Area. No active greater sage grouse leks were found within the Project Area during a March and April 2001 survey. However, one active lek was located approximately 1.75 miles north of the Project Area. The two-mile nesting buffer area around that lek encompasses about 536 acres of the northern and eastern portions of the Project Area.

Raptors

Several species of raptors occur or potentially occur within the Project Area. They include the golden eagle, northern harrier, sharp-shinned hawk, Cooper's hawk, northern goshawk, red-tailed hawk, Swainson's hawk, rough-legged hawk, ferruginous hawk, American kestrel, merlin, prairie falcon, peregrine falcon, short-eared owl, long-eared owl, great-horned owl, and burrowing owl.

Helicopter surveys in and around the Project Area were conducted during late May 2001 to locate raptor nests. No active raptor nests were found within the Project Area or a one-mile buffer around the Project Area. One inactive ferruginous hawk nest was found within the Project Area. Six additional inactive ferruginous hawk nests were found within one mile of the Project Area. One inactive golden eagle nest and one inactive unknown raptor nest were also found within one mile of the Project Area.

Threatened and Endangered Species - Wildlife and Fish

Wildlife Species

Black-footed Ferret and Associated White-tailed Prairie Dog Colonies

In Wyoming, large white-tailed prairie dog (Cynomys leucurus) colonies provide habitat for black-footed ferrets. Aerial surveys for prairie dog colonies were conducted over the Project Area in late March and early April 2001. Portions of four prairie dog colonies occur within the Project Area. These four colonies are part of a larger prairie dog complex that stretches north, south, and west of the Project Area. During a July 2001 survey all four colonies were found to exceed 200 acres in size and to have burrow densities of eight burrows per acre. Therefore, these colonies are considered potentially suitable habitat for black-footed ferrets (HWA 2001). A nocturnal survey for b~~B~~lack-footed ferrets was conducted in August 2001 over the entire prairie dog town and no ferrets or their sign were found (HWA~~,~~ 2001).

Mountain Plover

The Project Area was surveyed for mountain plover habitat in May 2001. No mountain plovers were observed in habitat patches during surveys, although the presence of prairie dog towns indicates that plovers may use these areas some times.

Bald Eagle

Incidental sightings of bald eagles have been recorded in the vicinity of the Project Area (HWA 2001). Most observations were documented between November and March, indicating that the area is commonly hunted by bald eagles during the winter months. However, the occurrence of communal winter roosts in or near the Project Area has not been documented. Inspection of BLM and WGFD raptor nest records and the results of aerial and ground raptor nest surveys conducted suggest bald eagle nests do not occur within two miles of the Project Area. The closest known nest occurs approximately 21 miles southwest of the Project Area. This nest has been active each of the last five years.

Canada Lynx

It is unlikely that Canada lynx occur within or near the Project Area. The Project Area does not include habitat types preferred by this species and does not support a population of snowshoe hares (preferred prey). Additionally, the occurrence of recorded lynx sightings in or near the Project Area has not been documented. The closest potentially suitable habitats are located more than ten miles away in the Sierra Madre Mountains (HWA 2001).

Fish Species

Four federally endangered fish species may occur within the Project Area or as downstream residents of the Little Snake River system: Colorado pikeminnow (Ptychocheilus lucius), bonytail (Gila elegans), humpback chub (Gila cypha), and razorback sucker (Xyrauchen texanus) (FWS 2000). These fish species have not been found in the Project Area and are not likely to be found downstream in the mainstem of the Little Snake River and its tributaries. Critical habitat for these species has not been designated in Wyoming (Upper Colorado River Endangered Fish Recovery Program 1999). Suitable habitat for spawning, age-0, and juveniles of these species may be present in the Project Area or downstream in Muddy Creek or the Little Snake River. The potential for downstream impacts to these tributaries of the Colorado River warrants their inclusion in this analysis.

The Colorado pikeminnow, bonytail, and humpback chub are all members of the minnow family. The razorback sucker is a member of the sucker family. All four of these fish species share similar habitat requirements and historically occupied the same river systems. Declines in populations of these species are mainly attributed to impacts of water development on natural temperature and flow regimes, creation of migration barriers, habitat fragmentation, the introduction of competitive and predatory non-native fishes, and the loss of inundated bottom lands and backwater areas (Minckley and Deacon 1991, FWS 1993).

Colorado Pikeminnow

Although one adult was collected from the Little Snake River in Carbon County, Wyoming, in 1990, subsequent survey attempts to collect Colorado pikeminnow from this area of the Little Snake River by WGFD personnel failed to yield any other specimens (Baxter and Stone 1995). Muddy Creek and the Little Snake River may potentially support this species of fish at certain times, but the pikeminnow appears to be absent downstream from the Project Area at this time.

Bonytail and Humpback Chub

Neither of these species has ever been reported within waters of the Project Area or immediately downstream. However, the Little Snake River, and although very unlikely, parts of Muddy Creek, may have the potential to provide habitat for both bonytail and humpback chub.

Razorback Sucker

Suitable habitat for this species is not available in the Project Area and the species is not known from the Little Snake River drainage.

Species of Concern - Wildlife and Fish

Wildlife Species of Concern

Nine special-concern species of wildlife occur or potentially occur in the Project Area. They are the Wyoming pocket gopher, swift fox, northern goshawk, Columbian sharp-tailed grouse, snowy plover, burrowing owl, Brewer's sparrow, Sage sparrow, and smooth green snake (HWA 2001).

Burrowing owls are typically associated with prairie dog burrows. Burrowing owls may utilize prairie dog towns, however, the total disturbance that would occur in prairie dog towns is small, and burrowing owls are not expected to occur in the Project Area. No Columbian sharp-tailed grouse leks are located within two miles of the Project Area. No winter habitat (upland shrub communities and wooded riparian areas) for Columbian sharp-tailed grouse is located in the Project Area. The Wyoming pocket gopher is typically associated with loose gravelly soils in greasewood plant communities and may be present in the Project Area. Brewer's sparrow and the Sage sparrow are sagebrush obligate species. These species and their sensitivity status/rank are listed in **Appendix E**.

Fish Species of Concern

Fish species that are not listed as endangered or threatened by the FWS, but have been identified for possible listing in the future, are classified as candidate species and are included on the BLM (2001) Sensitive Species List. Four fish species that have the potential to occur, or are known to occur downstream of the Project Area, are designated as "species at risk" by the FWS and are considered sensitive by the BLM. These species are described below.

The four BLM sensitive fish species that may occur within as wells as downstream from the Project

Area are the roundtail chub (Gila robusta), bluehead sucker (Catostomus discobolus), flannelmouth sucker (Catostomus latipinnis), and Colorado River cutthroat trout (Oncorhynchus clarki pleuriticus) (WYNDD 2000, BLM 2001). All four of these species can be found within Muddy Creek or immediately downstream from its confluence with the Little Snake River. Recent sampling of Muddy Creek by the BLM does not indicate that the bluehead sucker is found in large numbers. Recent sampling by the BLM also showed that the flannel mouth sucker is the least abundant fish in Muddy Creek. Suitable habitat for spawning, age-0, and juveniles of these species may be present in the downstream reach of Muddy Creek or in the Little Snake River. Wild Cow Creek, Dry Cow Creek and Cow Creek may also provide adult spawning habitat and age-0 rearing habitat. The potential for downstream impacts to these tributaries of the Colorado River warrants their inclusion in this analysis. Similar to the endangered fish species discussed previously, original numbers and distribution of these special-concern fishes have been reduced through the introduction of competitive and predatory non-native fish, habitat alterations that reduce or impair fish habitat and migration abilities, and unregulated fishing pressure.

The roundtail chub is a close relative of the federally endangered humpback chub and bonytail and is common within the Little Snake River drainage and can also be found in Muddy Creek (Carbon County, Wyoming). The bluehead sucker is restricted to the Little Snake and Green River basins in Wyoming (Baxter and Stone 1995) and occupies habitat similar to that of the roundtail chub. The species is known to occur in the Little Snake River and is found in large numbers in Muddy Creek (Baxter and Stone 1995). However, populations of the species in Wyoming are considered rare in comparison with other sucker species. The flannelmouth sucker is one of the most abundant and widely-distributed candidate fish species of the tributaries and mainstream portions of the Upper Colorado River Basin (Tyus et al. 1982) and is a limited resident of Muddy Creek (Baxter and Stone 1995). Colorado River cutthroat trout is one of five subspecies of cutthroat trout found in Wyoming and was the only trout native to the Green and Little Snake River drainages in Wyoming (Baxter and Stone 1995). The current populations of Colorado River cutthroat trout occupy less than one percent of the subspecies' original range. Some of the most genetically "pure" of the remaining populations of this trout subspecies are found in the Little Snake River in Carbon County, Wyoming (Baxter and Stone 1995).

RECREATION

The most popular recreational activities occurring in or near the Project Area are hunting, camping, and off-road vehicle use. No developed recreational sites, facilities, or special recreational management areas exist within or adjacent to the Project Area. Most recreation activities occur during the fall hunting seasons. The area attracts hunters during September and October for the greater sage grouse season. Pronghorn hunting also occurs in September. Other hunting use occurs during the mule deer season in mid-to-late October. Rabbits and predators are hunted later during the fall and winter. During other seasons, the area attracts small numbers of visitors engaged in rock collecting, camping and hiking, wild horse and wildlife observation, outdoor photography and picnicking. The area also receives a limited amount of use by off-road vehicle enthusiasts. Although data on recreational visitation are not available, overall use levels are generally low (BLM 2000). Low visitation is a function of the small number of local residents, long drives from major population centers, lack of publicized natural attractions, and road conditions that limit vehicle

access into many back country areas.

VISUAL RESOURCES

The Project Area is typical of the more rugged sections of Wyoming Red Desert region. The characteristic landscape within the Project Area and adjacent lands is moderately undulating. Numerous small drainages dissect the landscape, adding diversity. Larger views encompassing several viewsheds are available from high points. The sky/land interface is a significant aspect of all distant views. The predominant vegetation types, typical of cold desert steppe, are alkali and low sagebrush, mixed desert scrub, and grasses and forbs with scattered patches of big sage/rabbit brush on flatter north and east facing slopes, along drainage ways and in large depressions. Small established stands of juniper also exist within the Project Area. The combination of plant communities creates a subtle mosaic of textures and colors. Predominant vegetation colors in early spring are green and gray green changing to gray/green and buff/ochre as grasses and forbs cure in the summer and fall. Reddish brown and buff colors of the badland formations add contrast and dominate in areas of steep topography. Evidence of cultural modification in the Project Area includes unimproved roads and some oil and gas production facilities. Motorists traveling Wyoming Highway 789 would not have visual access to the Project Area because of the viewing distance (three to six miles) and intervening elevated topography. However, facilities and activities located on ridge lines or buttes are visible over longer viewing distances. The quality of the visual resource is an important part of the recreational experience for many of these users. Other non-recreational users of the area, including grazing permit holders and those working in the oil and gas industry, would also be affected by changes to the visual landscape.

The visual resource management class of the Project Area is Class III. Class III includes areas where changes in the basic elements (form, line, color, or texture) caused by a management activity may be evident in the characteristic landscape. The objective of this class is to provide for management activities that may require modification of the existing character of the landscape. However, changes should remain subordinate to the visual strength of the existing character.

CULTURAL RESOURCES

Culture Chronology

Archaeological investigations in the Washakie Basin indicate the area has been inhabited by prehistoric people for at least 10,000 years from Paleoindian occupation to the present. The accepted cultural chronology of the Washakie Basin is based on a model for the Wyoming Basin by Metcalf (1987) and revised by Thompson and Pastor (1995). The Wyoming Basin prehistoric chronology is documented in **Tables 3-11** and **3-12**.

Table 3-11
Prehistoric Chronology of the Wyoming Basin

Period	Phase	Age (B.P.)
Paleoindian		12,000 - 8,500
Early Archaic	Great Divide	8,500 - 6,500
	Opal	6,500 - 4,300
Late Archaic	Pine Spring	4,300 - 2,800
	Deadman Wash	2,800-2,000/1,800
Late Prehistoric	Uinta	2,000/1,800 - 650
	Firehole	650 - 300/250
Protohistoric		300/250 - 150

Source: Metcalf (1987), as modified by Thompson and Pastor (1995)

Table 3-12
Historic Chronology of the Washakie Basin

Phase	Age A.D.
Pre-Territorial	1842 - 1868
Territorial	1868 - 1890
Expansion	1890 - 1920
Depression	1920 - 1939
Modern	1939 - Present

Source: Massey 1989

Historic use of the Washkie Basin area is limited by the formidable topographic relief. Steep canyons, inadequate water supply, badlands, and escarpments make the area inhospitable for settlement with only limited ranching activities present.

Block cultural inventory of the Blue Sky Project Boundary and surveys of a proposed pipeline route and existing access road that would be upgraded located three previously recorded sites, 16 newly recorded prehistoric sites, and 11 isolated finds (Hatcher and Davis 2001). Site types included the historic Rawlins-Baggs Stage Road and prehistoric open camps and lithic scatters.

Summary of Cultural Resources

Prior to fieldwork, the Wyoming Cultural Records Office was contacted to request a file search. Limited amounts of field work have resulted in the documentation of cultural resources through survey, examination of ethnographic records, and historic record research. No excavations have been conducted in the Project Area.

In southwest Wyoming, sand deposits (dunes, shadows, and sheets) are recognized as highly likely

to contain cultural material. The Project Area is located in an area of dominant northwest/southeast trending ridge systems that have been heavily cut with numerous drainages of Muddy Creek, Cow Creek, Wild Cow Creek, and Dry Cow Creek. These drainages have dissected the surrounding ridge systems, resulting in variable topography containing lesser ridges, finger ridges, knolls, hills, and gentle to moderate slopes. This topographic setting is conducive to prehistoric occupation.

A Class III block inventory for the Project Area was conducted in May 2001 by Pronghom Archaeology (Pronghorn). At the conclusion of the survey, one prehistoric lithic scatter, 14 prehistoric open camps, one isolated hearth, and 11 isolated finds were identified and recorded. Eleven sites are considered eligible for the National Register of Historic Places. In addition, three previously recorded sites, two of which are eligible for the National Register of Historic Places, were relocated and re-recorded.

Two archaeological projects near the Project Area have investigated prehistoric site distribution and site density in the Savery Creek drainages. In Archaeological Investigations Within the Little Snake River Basin Colorado and Wyoming, H.D. Hall (1987) "reevaluated the nature and distribution of aboriginal sites" in Savery Creek, Slater Creek, Ridge and Valley geographic zones, Juniper Ridge, and the Little Snake Valley. The Savery Creek investigations indicate that sites are generally located in the valley bottom or lower valley terrain, on gentle inclines, near water and near major confluences. The Savery-Pothook study area is located in northwestern Colorado and south-central Wyoming. Situated along a 30-mile stretch of the Little Snake River in the vicinity of Baggs, Wyoming, the study area includes several major tributaries. The tributaries are: Slater Creek, Four-Mile Creek, Thornburgh Gulch, Savery Creek, and Cottonwood Creek.

In the Class III Cultural Resource Inventory and Evaluation of Eleven Prehistoric Sites within the High Savery Locality at the Proposed High Savery Dam and Reservoir Alternative, Carbon County, Wyoming, Latham (1999) states, "The analysis domain is characterized by nondissected to moderately-dissected uplands with mostly moderate-to-steep slopes and broad-to-narrow benches and flood plains along the many streams that pass through the area." Most of the prehistoric sites within the analysis domain are situated on benches or ridges overlooking one of the main tributaries. The High Savery Dam project is located approximately 12 miles east of the of the Project Area.

Site Types

Site types previously identified, recently located, or predicted to be in the Project Area are discussed below.

- Prehistoric open camps contain evidence of a broad range of activities including subsistence-related activities. Cultural remains include formal features, lithic debris, chipped stone tools, evidence of milling/vegetable processing activities including ground stone, and pottery.

- Lithic scatters consist of sites containing lithic debris such as debitage or stone tools.

- Quarries are sites where lithic raw material was obtained and initially processed. Primary and secondary lithic procurement areas are geologic locations where chert and quartzite cobbles have been redeposited and later used by prehistoric inhabitants for tool manufacture.

- Human burials, rock art, both pictographs and petroglyphs, and rock alignment sites are unknown in the Project Area, but have been identified as sensitive or sacred to Native Americans. Few of these types of sites have been located in southwestern Wyoming.

- Pottery/ceramics are as yet undocumented in the Project Area. Pottery is associated with the Uinta phase of the Late Prehistoric period. There are numerous pottery sites in southwestern Wyoming and northwestern Colorado.

- The Rawlins-Baggs Stage Road is a historic route considered eligible for inclusion within the National Register of Historic Places (Hatcher and Davis 2001). However, despite an intense search during the block survey, no physical evidence of this trail was found.

Excavation Data

No sites have been extensively tested or excavated in the Project Area. However, several excavations have been conducted in the surrounding area, contributing data about the prehistory and history of the area.

The Sheehan site is a multi-component prehistoric site (Bower et al.1984) located in the Washakie Basin, east of the Project Area. Component I dates to the Archaic period and Component II dates to the Late Prehistoric period. Data suggests both components reflect short-term winter camps with meat processing activities identified and locally available lithic materials exploited. The Yarmony site in northwest Colorado contained a housepit dating to approximately 6300 B.P. (Metcalf and Black 1991). The Early Archaic period housepit is a large, semi-subterranean, two-room dwelling containing four slab-lined storage bins, interior hearths and other floor features, and is postulated as a long-term winter base camp. The Nova Site is located approximately four miles northwest of the Project Area block. The site is a Uinta phase housepit dating from 1098 to 1285 B.P. and represents Component I as a short-term spring/late summer occupation. Component II was not dated but is believed to occur as the reuse of the Component I housepit.

Summary

The proximity of the block survey areas to important drainages suggest that the survey area is located where the potential for open camps, and lithic scatter is fairly high. The sampling included ridges, drainages, and areas with limited sand deposits. Certain topographic settings have greater archaeological sensitivity including eolian deposits (sand dunes, sand shadows, and sand sheets), and to a limited degree, colluvial deposits along lower slopes of ridges. Previous investigations along the Savery Creek drainages, east of the Project Area, support a higher site potential along streams.

At the conclusion of the inventory, three previously-recorded sites, 16 newly recorded prehistoric sites, and 11 isolated finds were discovered. Eleven of these newly discovered sites are considered eligible for the National Register of Historic Places. No evidence of the Rawlins-Baggs Stage Road was found.

SOCIOECONOMICS

The primary geographic area of analysis for potential socioeconomic effects is Carbon County, Wyoming, and the communities of Baggs, Dixon, and Rawlins. Temporary housing availability is also described for the Moffat County, Colorado community of Craig, and the Sweetwater County, Wyoming, community of Wamsutter. Carbon County socioeconomic conditions characterized for the assessment include economic and population conditions, temporary housing resources, law enforcement and emergency management services, certain local and state government revenues and local attitudes and opinions.

Economic Conditions

Carbon County has a natural resource-based economy. Basic economic sectors, which bring revenues into the county, include oil and gas production and processing, coal mining, electric power generation, agriculture (primarily ranching and logging), some manufacturing and transportation (primarily the Union Pacific railroad). Those portions of the retail and service sectors which serve travelers and tourism and recreation visitors are also basic. Employment and earnings are two common measures of economic activity. The mining sector, which includes oil and gas employment, would be the primary sector affected by CBM exploration or development.

In 1998, Carbon County employment totaled 9,780 full and part-time jobs, which was about one percent lower than the 1990 level (WDAI 2000a) and about 28 percent lower than the 1980 level of 13,560 jobs. Mining sector employment, which includes oil and gas jobs, decreased 46 percent from 1990 to 1998, from 934 to 501 jobs. The 1998 level was 86 percent lower than the 1980 level of 3,563 jobs mining jobs (UW 1997). The mining sector losses and the volatility in total employment are attributed to the shutdown of the Rosebud and Seminoe # 2 mines (BLM 1999a) and more recently the RAG Shoshone mine near Hanna (Rawlins Daily Times 2000a). Other mine workforce reductions and the delay in opening of an anticipated mine have further affected mining sector employment in the county, however, increased natural gas drilling has resulted in increases in oil and gas employment in recent years (Schnal 2000).

In Carbon County, ten-year unemployment rates ranged from a low of 5.2 percent (1997) to a high of 6.1 percent (1993). The 1999 Carbon County unemployment rate was 5.3 percent, based on 446 unemployed persons out of a total labor force of 8,475 (Wyoming Department of Employment 2000).

Carbon County earnings increased from $202 million to $211 million between 1990 and 1998, a 5 percent increase. However, when adjusted for inflation, Carbon County earnings decreased by 21 percent from their 1990 level during the eight-year period.

Oil and Gas Activities

Carbon County natural gas production increased from 76 million MCF in 1995 to about 80 million MCF during 1999. Carbon County oil production in 1999 was within 0.2 percent of the 1995 level of 1.3 million barrels.

One indicator of future production, approved Applications for Permits to Drill, increased steadily in Carbon County in recent years, from 50 in 1995 to 127 in 1999. Increased drilling may result in increased production in the county if drilling efforts are successful and commodity prices increase or stabilize at economic levels. During 1999, there were a total of 742 producing oil and gas wells in Carbon County (WOGCC 1995-1999).

Economic Activities

Other economic activities occurring in and near the Project Area include oil and gas exploration (Vosika Neuman 2000), cattle grazing (Warren 2000) and outdoor recreation activities such as hunting (pronghorn antelope, mule deer, elk and upland birds), hiking, off-road vehicle use, camping and sightseeing. Many commercial hunting outfitters hold permits for the hunt areas where the Project Area is located, although the Project Area comprises only a small portion of these hunt areas (Clair 2000).

Population

Carbon County population growth and decline parallels the employment boom and bust cycle outlined at the beginning of this section. For example, the 2000 Carbon County population (15,639) was 29 percent lower than its 1980 level of 21,896 (WDAI 2001). Between 1990 and 2000, the City of Rawlins, the largest community in Carbon County, lost an estimated 842 persons to end the period at 8,538, although the city is growing as a result of the opening of a new state prison facility. The Town of Baggs gained 76 residents or 28 percent of its 1990 population, and the Town of Dixon, several miles east of Baggs, gained 12 persons to end the period with an estimated population of 79.

Temporary Housing Resources

CBM interim drilling activities typically involve relatively short duration tasks performed primarily by contractors. The nature of these activities results in demand for temporary housing resources such as motel rooms and mobile home and recreational vehicle (RV) spaces near the Project Area.

In the Baggs/Dixon area, most temporary housing resources are fully-occupied by oil and gas workers during the summer. During winter more units become vacant. A 26-space mobile home park in Baggs is equipped to accommodate RVs as well as mobile homes. Within the park there are several rental mobile homes. There is a small four-space mobile home park in Savery and a number of mobile home lots scattered throughout the Little Snake River Valley (Grieve 2000).

There are two motels in Baggs with a total of 64 rooms, most of which can accommodate several guests. Both motels routinely accommodate oil and gas industry workers as well as tourists, travelers and hunters. As with mobile home parks, the motels are filled to capacity during the summer and fall and are partially vacant during the winter. Most oil and gas occupants are relatively short-term in nature, moving in and out of the community as work assignments are completed (Willis 2000, Hawkins 2000). Longer-term rental housing in the Baggs/Dixon area consists primarily of an apartment building and a newly constructed rental duplex which was vacant in the spring of 2001.

There are temporary housing resources available in the Town of Wamsutter, including several mobile home parks and two motels (Carnes 2000). The town is the center of a 200-well per year BP drilling and field development program. Wamsutter town officials recently stated that there was no available housing in the town to accommodate workers and their families associated with the current drilling and field development activity (Rock Springs Rocket Miner 2001).

Temporary housing resources in the Craig, Colorado, and Rawlins, Wyoming, areas are more extensive. The Craig Chamber of Commerce lists 12 motels with a total of 467 rooms and 2 campground/RV parks with a total of 128 spaces(Craig Chamber of Commerce 2000). Rawlins has 19 motels and 4 RV parks (Hiatt 2000). There are also a substantial number of apartment buildings with some availability (Hewitt 2000, Rawlins Daily Times 2000b).

Local Government and State Government Revenues

Local and state government fiscal conditions most likely to be affected by the interim drilling activities include county, school and special district ad valorem property tax revenues, state, county and municipal sales and use tax revenues, state severance taxes, and federal/state mineral royalty distributions. Some county, municipal and special district service expenditures may also be minimally affected.

Ad Valorem Property Tax

Carbon County assessed valuation in fiscal year (FY) 2000 totaled about $337 million, which yielded total property tax revenues of $21.3 million. Total mill levies within Carbon County communities ranged from 65 to 75.3. FY 2000 assessed valuation from 1999 natural gas production totaled $159 million or about 47 percent of total assessed valuation. Assessed valuation from oil production totaled 16.9 million or about five percent of total valuation (WTA 2000).

Sales and Use Tax

FY 2000 sales and use tax collections in Carbon County totaled about $21 million. These include collections from a four percent statewide sales and use tax, a one percent general purpose local-option sales and use tax and a one percent specific-purpose local option sales and use tax, which expired in the summer of 2001 (WDAI 2000b).

Severance Taxes

In Wyoming, severance taxes are levied against certain minerals produced in the state, including a six percent severance tax on natural gas. In FY 2000, severance tax distributions totaled $275 million (WDAI 2000c). Of the total, 44 percent was attributable to severance taxes on natural gas.

Federal Mineral Royalties

The federal government collects a 12.5 percent royalty on oil and natural gas extracted from federal lands. After certain costs are deducted, half of those royalties are returned to the state where the production occurred. In Wyoming, the state's share is distributed to a variety of accounts, including the University, School Foundation Fund, Highway Fund, Legislative Royalty Impact Account, and cities, towns and counties. During FY 2000, a total of $309 million in federal mineral royalty funds were distributed to Wyoming entities (WDAI 2000d).

State Mineral Royalties

The State of Wyoming collects a 16.7 percent royalty on the fair market value of gas produced from state leases, less production and transportation costs. During FY 2000 state leasing income was $35 million (PRCBMIC 2001).

Attitudes and Opinions

A 1996 survey conducted in conjunction with the preparation of the Carbon County Land Use Plan provides some insight into resident attitudes and opinions regarding land use, oil and gas development, natural resource conservation and use and other topics. Just over 300 residents completed the survey, yielding an estimated statistical reliability of about 95 percent (Pederson Planning Consultants 1998).

Water resource conservation and concern for government regulation of land use were the most frequently listed important land use issues, followed closely by the availability of water to support future land uses, the economic viability of ranching, timber, and oil and gas industries, and the need to conserve wildlife habitat.

County-wide, 54.9 percent of survey respondents (based on a weighted average; some respondents indicated more than one response) indicated that conservation of land, water, and wildlife resources was more important than increased oil and gas production, while 36.9 percent indicated that increased oil and gas production was more important. However, among Baggs respondents, the reverse was true. About 54 percent indicated that increased oil and gas production was more important than conservation of land, water and wildlife resources while 36 percent indicated that resource conservation was more important. The land use plan attributes this difference to Baggs' greater economic dependence on future oil and gas employment.

Concerning management of federal lands, the largest number of respondents (69.5 percent) indicated that more federal lands within the county should be designated for the purpose of conserving fish and

wildlife habitat and surface and groundwater resources. In addition, 60.8 percent of respondents indicated that more land should be designated for public recreation, 48.8 percent indicated more land should be leased for oil and gas industry exploration and production, 48.7 percent indicated more land should be leased for commercial mining, and 44.5 percent indicated more land should be made available to local timber companies for commercial timber harvest.

Coalbed methane development was not considered during the survey. Resident attitudes and opinions about unique aspects of CBM are not known (Hewitt 2000).

Environmental Justice

Executive Order (EO) 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations" was published in the Federal Register (59 FR 7629 on February 11, 1994). EO 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations (defined as those living below the poverty level). The EO makes clear that its provisions apply fully to American Indian populations and Indian tribes, specifically to affects on tribal lands, treaty rights, trust responsibilities, and the health and environment of Indian communities.

Communities within Carbon County, entities with interests in the area, and individuals with ties to the area all may have concerns about the presence of CBM development within the Project Area. Communities potentially impacted by the presence or absence of the proposed development have been identified above in this section. Environmental Justice concerns are usually directly associated with impacts on the natural and physical environment, but these impacts are likely to be interrelated to social and economic impacts as well.

Native American access to cultural and religious sites may fall under the umbrella of environmental justice concerns if the sites are on tribal lands or access to a specific location has been granted by treaty right. With regard to environmental justice issues affecting Native American tribes or groups, the Project Area contains no tribal lands or Indian communities, and no treaty rights or Indian trust resources are known to exist for this area.

TRANSPORTATION

The regional transportation system serving the Project Area includes an established system of interstate and state highways and county roads. Local traffic on federal land is served by improved and unimproved BLM roads.

Access to the Project Area is provided by a combination of interstate highway, state highways, and county and BLM roads. **Table 3-13** displays specific access routes to the Project Area. The Wyoming Department of Transportation (WYDOT) measures average daily traffic (ADT) on federal and state highways. ADT on highways providing access to the Project Area are shown in **Table 3-13**.

Table 3-13 Access Routes to the Project Area		
Highway or Road		
Highway or Road	**ADT**	**Level of Service / Accidents**
I-80	Rawlins - Wamsutter: 10,670 (6,170 trucks)	A 1999: 89 5 yr average: 112.4
SH 789	(1) @ I80/ Crestone Junction: 850 (160 trucks); (2) @ Baggs Corporate Limit: 1650 (190 trucks)	B 1999: 27 5 yr average 16.4
CCR 608 (Dad Road)	n/a	n/a

Sources: Wyoming Department of Transportation, Carbon County Road and Bridge Department

WYDOT assigns levels of service to highways in the state system. Levels of service (A through F) are assigned based on qualitative measures (speed, travel time, freedom to maneuver, traffic interruptions, comfort and convenience) that characterize operational conditions within traffic streams and the perceptions of those conditions by motorists. A represents the best travel conditions and F represents the worst. Levels of service for highways providing access to the Project Area are also shown in **Table 3-13**.

The Project Area would be accessed from SH 789 and CCR 608 (Dad Road). A new improved dirt road (less than one-quarter mile in length) would be constructed into the southern boundary of the Project Area. CCR 608 is a two-lane improved and unimproved native material road. CCR 608 currently provides access to oil and gas fields in the area (Evans 2000).

HEALTH AND SAFETY

Existing health and safety concerns in and adjacent to the Project Area include occupational hazards associated with CBM exploration and operations; risk associated with vehicular travel on improved and unimproved county and BLM roads; firearms accidents associated with hunting or casual firearms use; and low probability events such as landslides, flash floods and range fires.

Occupational Hazards

Two types of workers would be employed by the Project: oil and gas workers, who had a 1998 annual accident rate of 4.0 per 100 workers, and special trade contractors, who had a non-fatal accident rate of 8.9 per 100 workers (U.S. Department of Labor, Bureau of Labor Statistics 1998). These rates compare with an overall private industry average for all occupations of 6.2 per 100 workers.

There has been recent concern among CBM drillers that worker safety standards and training used for conventional oil and gas activities may not be appropriate for the CBM industry (Rock Springs Rocket Miner 2001). During 2000, five workers died and six others were seriously injured in CBM-related accidents in Campbell County, Wyoming. The Wyoming Occupational Safety and Health Administration, Worker's Safety Division (OSHA) is working with CBM company officials to consider changes in worker safety standards and revised training requirements.

Pipeline Hazards

Accident rates for gas transmission pipelines are historically low. Nationwide, injuries associated with gas transmission pipelines averaged 14 per year from 1990 through 1996, fatalities averaged one per year and incidents such as ruptures averaged 79 per year (U.S. Department of Transportation 1998).

Other Risks and Hazards

Highway safety impacts are discussed under Transportation. Sanitation and hazardous material hazards would exist during CBM activities.

The potential for firearms-related accidents would occur primarily during hunting season.

Risk of fire in the analysis area would occur under the Project.

NOISE

The Project Area is located in a sparsely-populated rural setting having modest sound disturbances. The principal sound source within the Project Area is the wind. Vehicle traffic on Wyoming State Highway 789, jet aircraft overflights at high altitudes, localized vehicular traffic on county, BLM and two-track roads in the Project Area, and nearby drilling activities also cause sound disturbances within the Project Area. The EPA has established an average 24-hour noise level of 55 dBA as the maximum noise level that does not adversely affect public health and welfare. No definitive data has been established concerning noise levels that affect animals. No regulations concerning quantitative noise levels have been established by the State of Wyoming.